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AIRS DETECTOR A/B WEIGHTS – POSSIBLE CHANGES FOR IMPROVED NOISE PERFORMANCE

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AIRS DETECTOR A/B WEIGHTS - UPDATE

- **Background on degradation in channel noise properties for a very small fraction of the AIRS channels**
  - ***Probably due to radiation effects***
- **Finding which of the 2 redundant detectors has degraded (A or B)**
- **Channels with "cold scene noise" also considered**
- **Criteria for selecting channels for weight changes**
  - ***The intention is to increase the reliability of the data for climate monitoring with little or no impact on weather forecasting***
- **Summary of channel counts**
- **Preliminary list of channels for which weight changes are proposed**
- **Additional data from "OBC Stare" tests**
- **Discussion**

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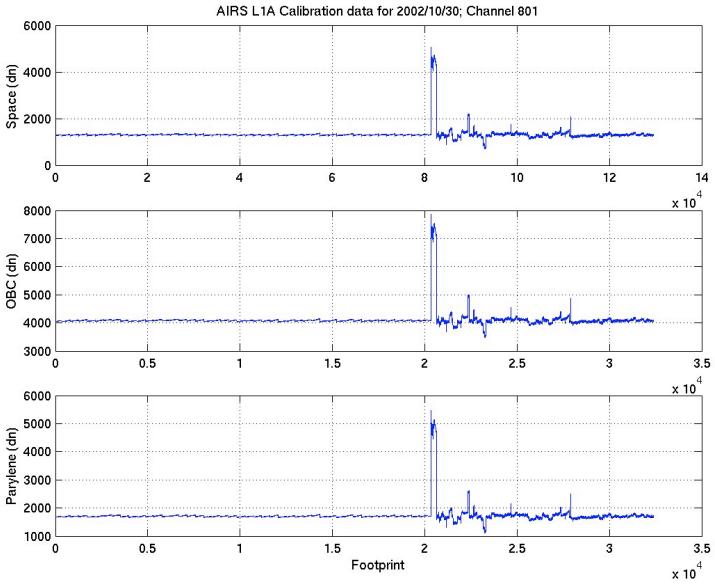
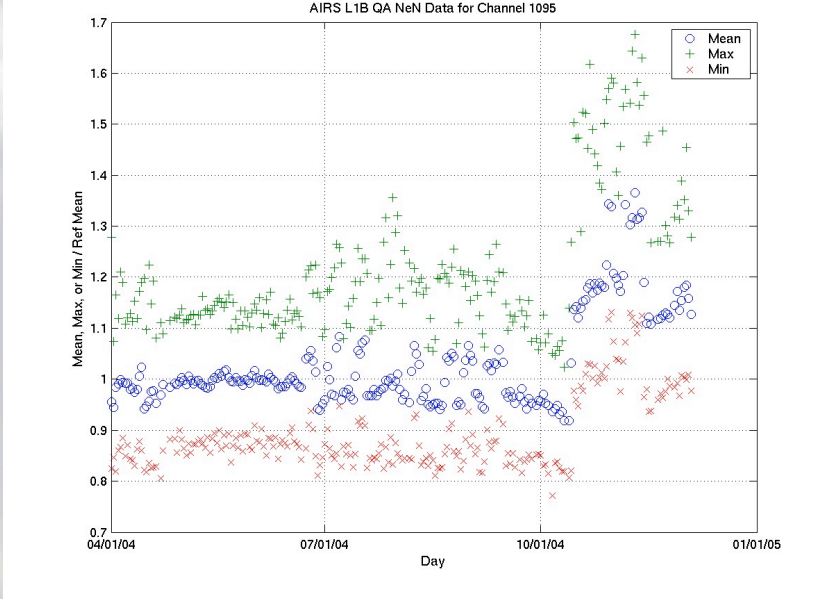
CHANNEL DEGRADATION

- **The vast majority of the AIRS 2378 IR channels continue to have excellent performance**
- **A small number of channels have exhibited a large increase in noise after radiation hits (in the SAA or near the poles); a few others have shown increased and/or variable noise, probably due to an accumulation of total radiation dose**





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"NOISY CHANNELS" LISTS

- Lists of "noisy" channels have been distributed periodically in recent years
- These channels were previously expected to have acceptable noise (in "good" states) but have had large numbers of high noise and/or pop flags (over 10 granules flagged per day)
- The total number of channels ever listed is 121 (out of 2378)
- Of these, 22 have recovered to acceptable noise levels and 26 more have noise levels that are higher than before but still acceptable
- Some of the 73 remaining degraded channels could be "rescued" by changing detector weight, for example if only the A detector had degraded for a channel with A=B weight

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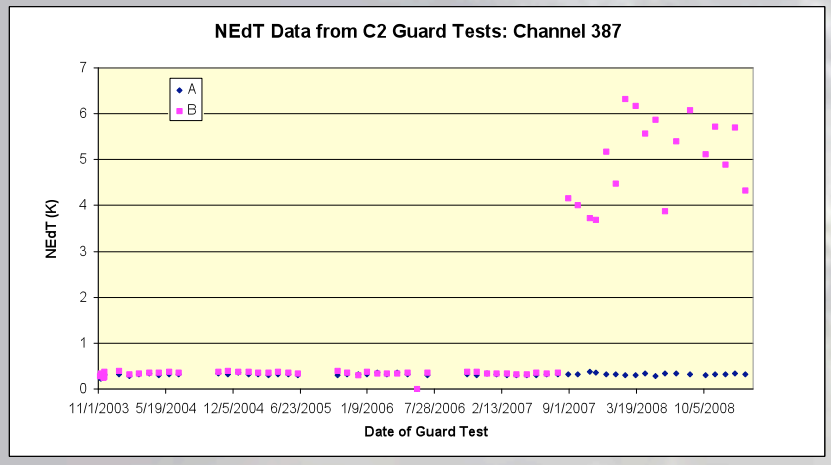
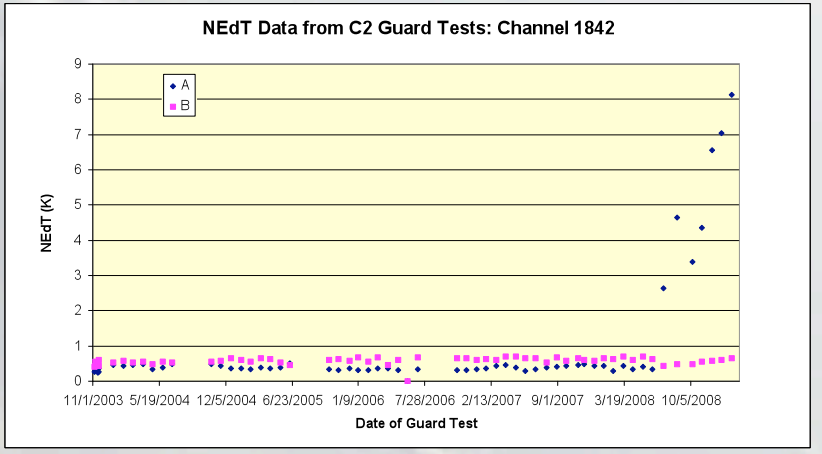
IDENTIFICATION OF DEGRADED DETECTORS (A or B)

- Guard tests are run about every month during spacecraft lunar roll maneuvers, during which a few minutes of L0 data are collected after A-only, B-only, and A/B Opt (operational) gain tables are loaded in sequence
- From the data the gain and NEdT are calculated
- For degraded channels, the NEdT data were examined to identify the detector involved





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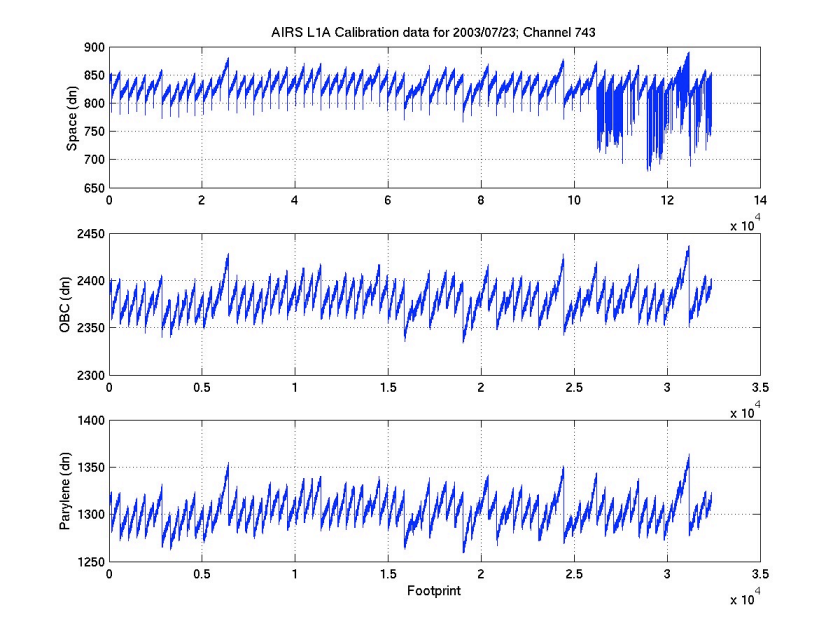
COLD SCENE NOISE

- **Some channels have occasionally shown large bursts of noise when viewing cold scenes, primarily during space looks**
- **A "cold scene noise" flag was developed to detect these events**
  - ***This is included in the high noise flag instead of being a separate flag***
- **Some channels exhibit these bursts frequently, detectable in plots of the NEdT daily maximum values**



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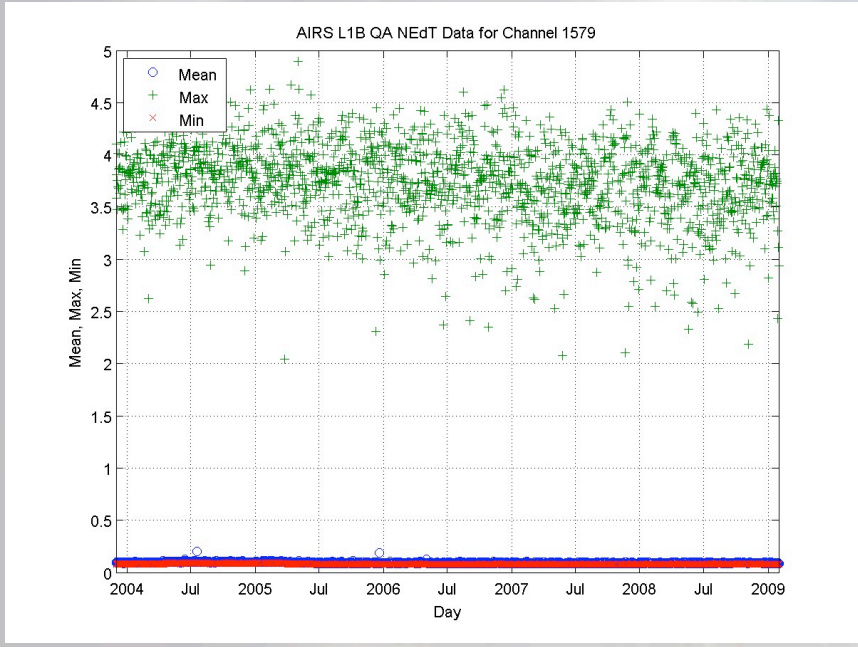
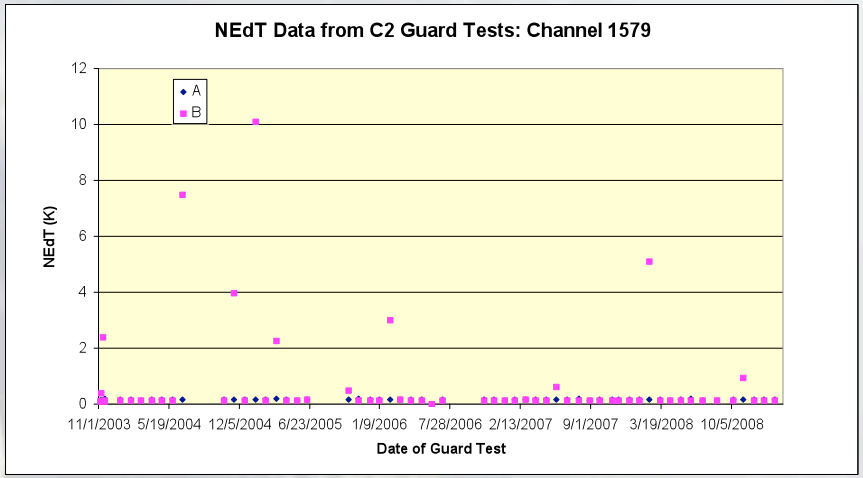
COLD SCENE NOISE, cont'd

- **A clear signature of cold scene noise is a large number of very high daily maximum NEdT values compared to the daily mean**
- **In some cases the Guard Test data indicates that one of the two detectors may be the unreliable one**





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CRITERIA FOR WEIGHT CHANGE

- **Of the 121 channels originally investigated, 22 appeared to have recovered**
- **An early list was distributed proposing 55 channels for weight changes; however it was suggested in response that only "essentially useless" channels should be included**
  - ***For about 26 channels, a simple change in nominal NeN values should eliminate the frequent high noise flags, i.e. the channel noise is higher than before but still acceptable***
- **The revised criterion is that the channel should have noise issues severe enough to compromise the OBC/space look calibration**
  - ***NEdT > 1K***
  - ***Very frequent occurrences of invalid NEdT from the PGE***
  - ***Really extreme cases of cold scene noise***
- **For 36 channels, the alternative detector was very noisy**
- **This leaves 37 channels for which weight changes are being recommended**
  - ***A revised preliminary summary spreadsheet of their properties has been distributed***

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SUMMARY OF CHANNEL COUNTS

Number of AIRS channels: 2378

Number in "poor" states: 176

Number in "good" states: 2202

Of these, total number of channels with degradations noted: 121

Channels "recovered": 22

Channels needing new limits (otherwise noise OK): 26

Channels without alternative detector: 36

Channels for which new weights are recommended: 37

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PRELIMINARY LIST OF CHANGES

Channel (PGEID)	Date of Onset	Location of Onset or Other Comment	V4 State	V5 State	Guard Test Comments	Upload New Weight?	freq (cm-1)	Zhou p1688 #	281 ch #	324 ch #	11/19/03 NEdT (K)	Test 192 AB NEdT (K)
300	1/10/2005	SAA	0	3	A degraded, B OK	B	735.69	285	108	116	0.64	2.13
302	9/5/2008	SAA	0	0	A degraded, B OK	B	736.308	287	#N/A	#N/A	0.26	1.53
373	current cycle	Cold scene noise	4	1	Both poor, B better?	B	758.917	#N/A	#N/A	#N/A	0.31	0.39
387	8/9/2007	SAA	0	0	B degraded, A OK	A	763.537	345	#N/A	#N/A	0.21	2.21
398	current cycle	NeN drifted up, then recovered	0	0	A better than B	A	767.205	#N/A	#N/A	#N/A	0.28	0.32
444	3/20/2008	South Pole	0	0	A degraded, B OK	B	789.971	384	#N/A	#N/A	0.34	1.89
453	3/25/2007	SAA	0	0	A degraded, B OK	B	793.171	389	118	129	0.26	2.18
480	11/22/2004	SAA	0	0	A degraded, B OK	B	802.922	402	#N/A	#N/A	1.00	1.04
526	7/4/2006	South Pole	0	3	B degraded, A OK	A	820.072	424	#N/A	#N/A	0.28	0.91
548	12/4/2005	South Pole	0	3	B degraded, A OK	A	828.522	439	#N/A	#N/A	0.27	1.89
600	12/30/2008	South Pole	0	0	B degraded, A OK	A	849.163	466	#N/A	#N/A	0.48	1.22
609	4/21/2006	SAA	0	0	A degraded, B OK	B	851.49	469	#N/A	#N/A	0.45	0.57
655	12/7/2008	North Pole	0	0	B degraded, A OK	A	865.849	502	#N/A	#N/A	0.22	2.34
679	6/1/2005	SAA	0	0	B degraded, A OK	A	873.55	523	#N/A	#N/A	0.19	NaNs
738	10/3/2005	SAA	0	3	B degraded, A OK	A	893.118	569	#N/A	#N/A	0.15	NaNs
760	current cycle	Popper and cold scene noise	4	1	Use B?	B	900.655	#N/A	#N/A	#N/A	0.29	0.33
784	current cycle	Cold scene noise	3	0	Use B?	B	916.229	#N/A	#N/A	#N/A	0.12	0.24
829	10/23/2008	SAA	2	2	Both poor, A better	A	932.669	630	#N/A	#N/A	0.16	2.25
850	4/1/2008	Increasing cold scene noise	3	3	A erratic, B OK?	B	940.55	#N/A	#N/A	#N/A	0.17	0.09
996	6/6/2005	SAA	0	0	B degraded, A OK	A	998.387	711	#N/A	#N/A	0.08	NaNs
1039	current cycle	Increasing cold scene noise	1	1	Use B?	B	1017.078	743	#N/A	#N/A	0.12	0.16
1046	11/10/2006	SAA	1	1	A degraded, B OK	B	1020.185	748	#N/A	#N/A	0.11	1.07
1126	current cycle	Cold scene noise	5	2	Use A?	A	1066.639	#N/A	#N/A	#N/A	0.13	0.17
1176	1/18/2006	SAA	0	0	B degraded, A OK	A	1091.407	842	#N/A	#N/A	0.13	NaNs
1180	7/7/2007	SAA	0	0	A degraded, B OK	B	1093.435	846	#N/A	#N/A	0.12	NaNs
1453	4/5/2007	SAA	0	0	B degraded, A OK	A	1333.393	1068	#N/A	#N/A	0.14	NaNs
1579	current cycle	missed cold scene noise	0	0	B erratic, A OK	A	1399.918	#N/A	#N/A	#N/A	0.09	0.10
1802	11/30/2003	old DCR failure, only briefly OK	2	5	B dead	A	1569.288	#N/A	#N/A	#N/A	0.83	NaN
1828	3/1/2007	SAA	0	0	B degraded, A OK	A	1587.688	1389	#N/A	#N/A	0.18	NaNs
1841	8/13/2005	North Pole	0	0	A degraded, B OK	B	1597.045	1400	#N/A	#N/A	0.22	0.58
1842	1/3/2007	NeN drifted up, stayed high	1	1	A degraded, B better	B	1597.769	#N/A	#N/A	#N/A	0.26	6.54
1946	3/5/2006	SAA	0	3	A erratic, B OK	B	2257.326	#N/A	#N/A	263	0.11	1.95
2067	1/7/2008	SAA	0	0	B dead, A OK	A	2347.831	#N/A	#N/A	#N/A	0.12	NaNs
2136	7/23/2005	SAA	0	3	B degraded, A OK	A	2414.828	1471	#N/A	#N/A	0.15	0.53
2288	3/26/2004	NeN drifted up, stayed high	0	0	B degraded, A OK	A	2569.315	1601	#N/A	#N/A	0.46	0.56
2357	current cycle	NeN drifted up, stayed high	0	3	B degraded, A OK	A	2642.213	#N/A	277	320	0.53	22.70
2373	4/5/2007	SAA	0	0	A degraded, B OK	B	2659.723	1684	#N/A	#N/A	0.35	0.41

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OBC STARE TESTS

- **Additional data are being collected during the current series of orbital adjustment maneuvers, during which the scan mirror is parked staring at the OBC**
  - ***The data are similar to the C7 Space View Noise test data except for the short wavelength modules where the high scene temperature affects the measured noise***
  - ***These data will be combined with the most recent C2 Guard Test data, using the "A/B opt" data analysis scripts, to produce a new set of recommended channel States***
- **These data will be assessed in comparison with the other data before a final list of weight changes is approved**

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DISCUSSION

- **The noise performance and calibration reliability of a small number of AIRS channels can be improved by changing the detector weights for those channels**
- **The changes are strongly recommended but subject to input from the user community**
- **The changes are probably too small to affect weather forecasting**
- **An issue is the potential loss of continuity of the data for climate monitoring**
  - ***A change in channel weight can result in a small change in the spectral centroid (less than about 0.5μm) [Strow et al., IEEE Trans. on Geoscience and Remote Sensing 41, 279 (2003)]***
- **A program could be supplied to make the small corrections to convert the radiances to those expected from the original weights (similar to the L1C spectral shift process)**